

PR271
Virtex-II Pro™ Design 4
TPS40021 DC/DC Controller-based Power Management Solution Providing $I_{CCINT} = 20A$
from $V_{IN} = 5 V$

FEATURES:

- Powers one or more FPGAs
- High efficiency minimizes heat
- Flexible controller (TPS40021) design allows optimization for size, power dissipation and cost
- Interchange SWIFT™ (TPS54xxx) device to support 1.5 A to 9 A load currents
 - o 1.5A and 3A synchronous SWIFT devices are pin-pin compatible
 - o 6A, 8A, and 9A synchronous SWIFT devices are pin-pin compatible
- Use of the TPS54x10 adjustable devices allow
 - o use of smallest inductor and/or specific type of output capacitor
 - o flexibility to re-compensate as needed, depending on the bypass/decoupling capacitors used with the FPGA
- In-rush current (for charging decoupling caps and FPGA start-up) that places a demand on the input power supply is minimized by the use of optional
 - o Integrated soft-start configured with an capacitor to provide 10 ms rise time for V_{CCINT} and V_{CCO}
 - o Sequential sequencing of V_{CCINT} , V_{CCAUX} and then V_{CCO} using PWRGD and ENABLE of each device
- High UVLO trip point and integrated soft-start of the 40K and SWIFT™ devices eliminates the need for an external Supply Voltage Supervisor (SVS) to monitor the input rail.
- Additional V_{CCO} rails easily added and sequenced (if desired) using the TPS54xxx PWRGD and ENABLE.
- RocketIO™ powered by ultra-low noise, high PSRR (for rejecting noise at the input from translating to the output) low dropout linear regulators (LDOs), TPS79xxx and TPS786xx. This series has been qualified by Xilinx to replace LT1963.
- The design meets Xilinx's V_{CCINT} and V_{CCO} start-up profile requirements, where applicable, including monotonic voltage ramp, in-rush current and power voltage ramp time requirements.

IMPORTANT WEB LINKS:

- Link to the TI home page for Xilinx FPGA power management solutions at <http://www.ti.com/xilinuxfpga> for more information and other reference designs.
- Link to the datasheets at <http://focus.ti.com/lit/ds/symlink/TPS40021.pdf> and <http://focus.ti.com/lit/ds/symlink/TPS54310.pdf>

- Link to 40K design software tool at <http://focus.ti.com/docs/toolsw/folders/print/tps40k-sw.html> to assist further optimization/customization of design.
- Link to SWIFT™ design software tool at <http://focus.ti.com/docs/toolsw/folders/print/swift-sw.html> to assist further optimization/customization of design.

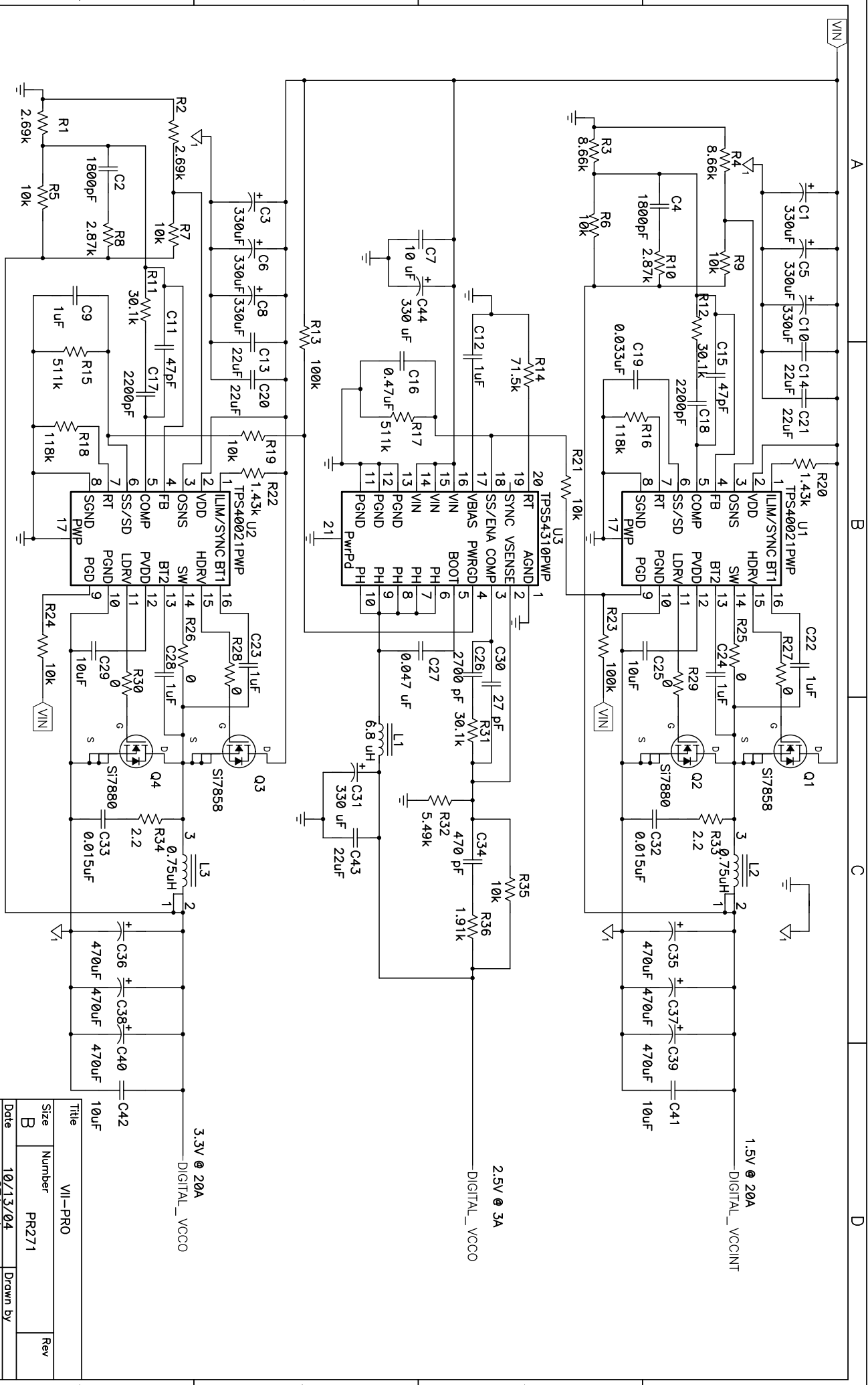
IMPLEMENTATION NOTES:

- **Sequencing:** Although Xilinx FPGAs **do NOT require it**, this reference design employs sequencing. This practice is consistent with good power supply design and prevents the input power supply from being pulled down due to in-rush currents for charging large capacitive loads.
- **Additional Capacitance:**
 - o The TPS40021s have been compensated to allow for up to the following additional capacitance on each rail:
 - 22 uF in ceramics in parallel with
 - two 470 uF capacitors, each with ESR between 0.1 and 2 ohms.
 If more bypass capacitance or bulk capacitors with ESR outside the range above is used, each TPS40021 may require re-compensation using the 40k design software.
 - o The TPS54310s have been compensated to allow for up to the following additional capacitance on each rail:
 - 12 uF in ceramics in parallel with
 - two 330 uF capacitors, each with ESR between 0.1 and 2 ohms.
 If more bypass capacitance or bulk capacitors with ESR outside the range above is used, each TPS54310 may need re-compensation using the SWIFT™ design software.
- **V_{CCAUX}:** V_{CCAUX} powers time-critical resources in the FPGA, including the Digital Clock Managers (DCMs). Therefore, this supply voltage is especially susceptible to power supply noise. V_{CCAUX} can share a power plane with V_{CCO}, but only if V_{CCO} does not have excessive noise. Changes in V_{CCAUX} voltage beyond 200 mV peak-to-peak should take place no faster than 10 mV per millisecond.
- **RocketIO:** When powering the RocketIO:
 - o A_{VCCAUTX}, V_{CCAUXRX}, A_{VTRX}, and A_{VTTX} may each be powered by their own linear regulator or by the same regulator if their voltages are the same. Keep power dissipation capability of the linear regulator package in mind.
 - o Select the appropriate TPS79xxx based on the load current requirement, and the power dissipation capability of the package. In general, the lower the current rating, the lower the price of the linear regulator. Power dissipation of linear regulators is explained in TI Application Note SLVA118.

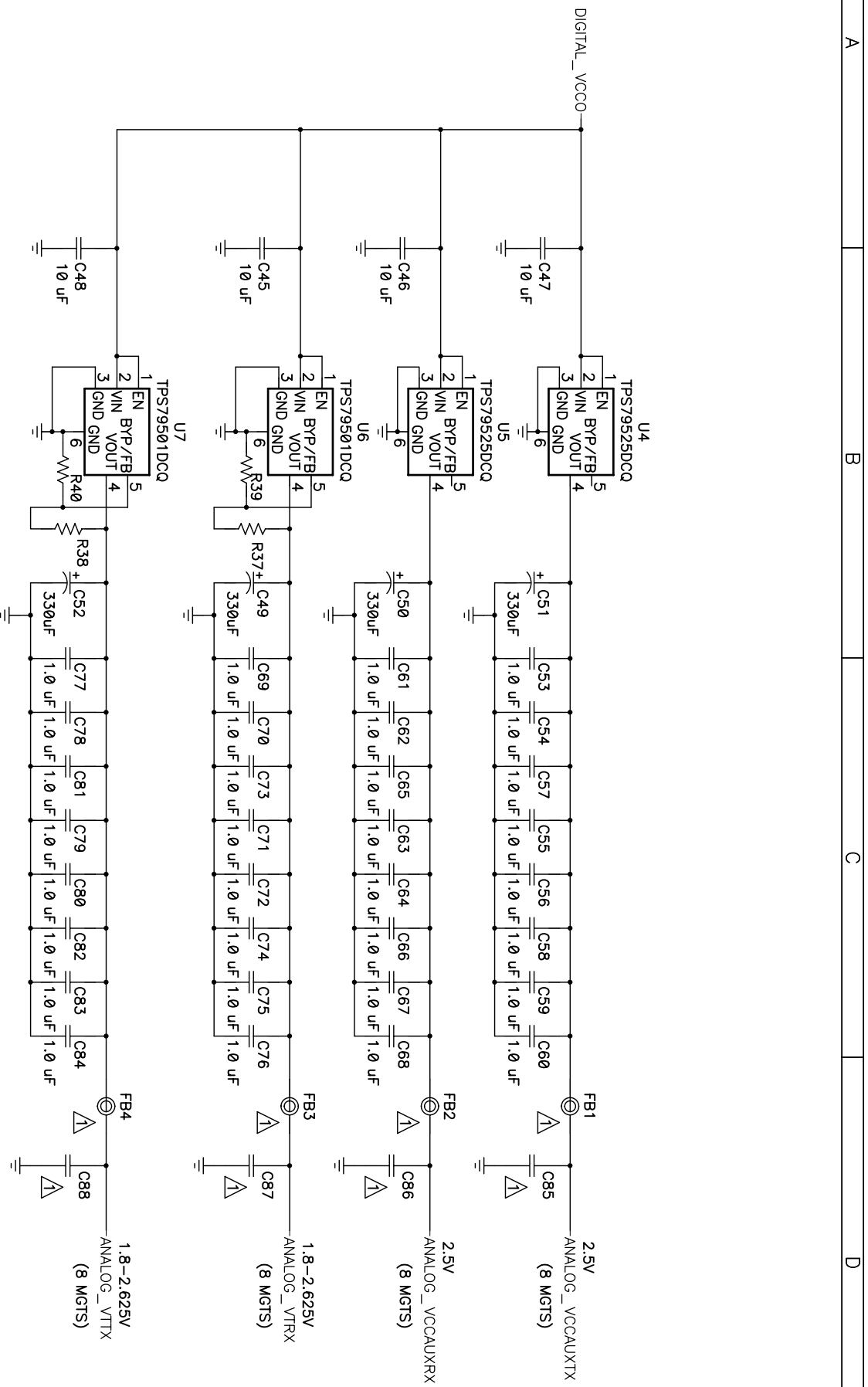
- o For the TPS79x01 adjustable devices, size the feedback resistors according to the datasheet. These resistors are not populated in the schematic.
- o All unused RocketIO transceivers must be connected to power (2.5V) and ground.
- **Modifications:** Adapt to $V_{IN} = 3.3\text{ V}$ by removing U2

QUESTIONS?

- Send an email to <mailto:fpgasupport@list.ti.com>



Title			VII-PRO	
Size	Number	PR271	Rev	
B	10/13/04	PR271	Rev	
Date	10/13/04	PR271	Rev	
Filename	pr271.sch	Sheet 1 of 2	Rev	



Refer to Xilinx's Rocket IO Transceiver User Guide
(UG024) for component values

Title			VII-PRO	
Size	Number	PR271	Rev	
B				
Date	10/13/04		Drawn by	
Filename	pr271.sch		Sheet 2 of 2	

Filename: PR271_bom.xls					
Date: 04/22/2004					
		PR271 BOM			
COUNT	RefDes	DESCRIPTION	SIZE	MFR	PART NUMBER
6	C1, C3, C5, C6, C8, C10	Capacitor, POSCAP, 330-uF, 6.3-V, 10-milliohm, 20%	7343 (D)	Sanyo	6TPD330M
2	C11, C15	Capacitor, Ceramic, 47-pF, 50-V, C0G, 5%	603	muRata	GRM1885C1H470JA01D
3	C12, C24, C28	Capacitor, Ceramic, 1-uF, 10-V, X7R, 10%	805	Taiyo Yuden	LMK212BJ105KD
2	C17, C18	Capacitor, Ceramic, 2200-pF, 25-V, X7R, 5%	603	Vishay	VJ0603Y222JXXAT
1	C19	Capacitor, Ceramic, 0.033-uF, 25-V, X7R, 5%	603	Vishay	VJ0603Y333JXXAT
2	C2, C4	Capacitor, Ceramic, 8200-pF, 25-V, X7R, 5%	603	Vishay	VJ0603Y822JXXAT
2	C22, C23	Capacitor, Ceramic, 1-uF, 10-V, X7R, 10%	805	Taiyo Yuden	LMK212BJ105KD
4	C25, C29, C41, C42	Capacitor, Ceramic, 10-uF, 6.3-V, 20%	1206	Taiyo Yuden	JMK316BJ106ML
1	C26	Capacitor, Ceramic, 2700-pF, 50-V, C0G, 5%	603	Vishay	GRM1885C1H272JA01D
1	C27	Capacitor, Ceramic, 0.047-uF, 25-V, X7R, 10%	603	Vishay	VJ0603Y473KXXAB00
1	C30	Capacitor, Ceramic, 27-pF, 50-V, C0G, 5%	603	muRata	GRM1885C1H270JA01D
2	C31, C44	Capacitor, Tantalum, 330-uF, 6.3-V, 600-milliohm, 20%	7343(D)	Vishay	293D337X96R3D2
2	C32, C33	Capacitor, Ceramic, 0.015-uF, 25-V, X7R, 5%	603	Vishay	VJ0603153KXXAT
1	C34	Capacitor, Ceramic, 470-pF, 50-V, C0G, 5%	603	muRata	GRM1885C1H471JA01D
6	C35, C36, C37, C38, C39, C40	Capacitor, POSCAP, 470-uF, 2.5-V, 10-milliohm, 20%	7343 (D)	Sanyo	2R5TPD470M
8	C45, C46, C47, C48, C49, C50, C51, C52	Capacitor, Ceramic, 2.2-uF, 6.3-V, X5R, 10%	805	muRata	GRM21BR60J225KC01
1	C7	Capacitor, Ceramic, 10-uF, 6.3-V, X5R, 10%	805	muRata	GRM21BR60J106KE01
7	C9, C13, C14, C16, C20, C21, C43	Capacitor, Ceramic, 22-uF, 6.3-V, 20%	1210	Taiyo Yuden	JMK325BJ226MM
1	L1	Inductor, SMT, 6.8-uH, 4.9-A, 23-milliohm		Coilcraft	MSS1260-682MXD
2	L2, L3	Inductor, SMT, 0.75-uH, 24-A, 3-milliohms	0.598 x 0.638	Sumida	CDEP149-0R7
2	Q1, Q3	MOSFET, NChannel, 12V, 29A, 3.0 milliohm	PWRPAK S0-8	Siliconix	Si7858DP
2	Q2, Q4	MOSFET, NChannel, 30V, 29A, 3milliohm	PWRPAK S0-8	Siliconix	Si7880DP
2	R1, R2	Resistor, Chip, 2.69k-Ohms, 1/16-W, 1%	603	Std	Std
3	R11, R12, R31	Resistor, Chip, 30.1k-Ohms, 1/16-W, 1%	603	Std	Std
2	R13, R23	Resistor, Chip, 100k-Ohms, 1/16-W, 1%	603	Std	Std

1	R14	Resistor, Chip, 71.5k-Ohms, 1/16-W, 1%	603	Std	Std
2	R15, R17	Resistor, Chip, 511k-Ohms, 1/16-W, 1%	603	Std	Std
2	R16, R18	Resistor, Chip, 118k-Ohms, 1/16-W, 1%	603	Std	Std
2	R20, R22	Resistor, Chip, 1.43k-Ohms, 1/16-W, 1%	603	Std	Std
6	R25, R26, R27, R28, R29, R30	Resistor, Chip, 0-Ohms, 1/16-W, 1%	603	Std	Std
2	R3, R4	Resistor, Chip, 8.66k-Ohms, 1/16-W, 1%	603	Std	Std
1	R32	Resistor, Chip, 5.49k-Ohms, 1/16-W, 1%	603	Std	Std
2	R33, R34	Resistor, Chip, 2.2-Ohms, 1/10-W, 1%	805	Std	Std
1	R36	Resistor, Chip, 1.91k-Ohms, 1/16-W, 1%	603	Std	Std
0	R37, R38, R39, R40	Resistor, Chip, xx-Ohms, 1/16-W	603		
8	R5, R6, R7, R9, R19, R21, R24, R35	Resistor, Chip, 10k-Ohms, 1/16-W, 1%	603	Std	Std
2	R8, R10	Resistor, Chip, 2.87k-Ohms, 1/16-W, 1%	603	Std	Std
2	U1, U2	IC, Enhanced, Low Input Voltage-Mode, Synchronous Buck Controller	HTSSOP-16	TI	TPS40021PWP
1	U3	IC, IFET Power Controller, Adj-V, 3A	PWP20	TI	TPS54310PWP
2	U4, U5	IC, LDO Linear Regulator Ultralow-Noise High PSRR Fast RF, 500mA, 2.5V	SOT223-6	TI	TPS79525DCQ
2	U6, U7	IC, Ultralow-Noise, High PSRR, Fast RF 250 mA, LDO Linear Regulators, AdjV	SOT223-6	TI	TPS79401DCQ

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